## Claims

[c1] What is claimed is:

1.An extrusion-free wet cleaning process for post-etch Cu-dual damascene structures, the process comprising:

providing a wafer comprising a silicon substrate and at least one post-etch Cu-dual damascene structure, the post-etch Cu-dual damascene structure having a via structure exposing a portion of a Cu wiring line electrically

connected with an N  $^+$  diffusion region of the silicon substrate and a trench structure formed on the via structure;

applying a diluted H  $_{2}^{\rm O}$  solution to the wafer to slightly oxidize the surface of the exposed Cu wiring line;

washing away cupric oxide generated in the oxidation step by means of a cupric oxide cleaning solution containing diluted HF, NH  $_4$  F or NH  $_2$  OH; and preventing Cu reduction reactions on the N  $^+$  diffusion region connected Cu

wiring line.

[c2] 2.The process of claim 1 wherein the Cu wiring line electrically connected with an N $^+$  diffusion region of the silicon substrate serves as a cathode in the cupric oxide cleaning solution.

[c3] 3.The process of claim 1 wherein the method of preventing Cu reduction reactions on the Cu wiring line comprises purging inert gas onto the wafer during the application to the wafer of the diluted H  $_2$  O  $_2$  solution.

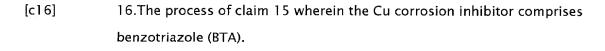
[c4] 4.The process of claim 1 wherein the method of preventing Cu reduction reactions on the Cu wiring line comprises adding a Cu corrosion inhibitor to the diluted H  $_2$  O  $_2$  solution.

[c5] 5.The process of claim 4 wherein the Cu corrosion inhibitor comprises benzotriazole (BTA).

[c6] 6.The process of claim 1 wherein the method of preventing Cu reduction reactions on the Cu wiring line comprises reducing the H  $_2$  O  $_2$  concentration of the diluted H  $_2$  O  $_2$  solution to below 100:1 (v/v).

[c7]	7. The process of claim 1 wherein the method of preventing Cu reduction
	reactions on the Cu wiring line comprises lowering the temperature of the
	diluted H $_{2}$ O $_{2}$ solution to below 15 $^{\circ}$ C during the application to the wafer
	of the diluted H $_{2}$ O solution.

- [c8] 8.The process of claim 1 wherein the method of preventing Cu reduction reactions on the Cu wiring line comprises increasing the pH of the acidic cupric oxide cleaning solution to above 7.
- [c9] 9.A wet cleaning process comprising:
  an oxidation step;
  an oxide etch step for washing away cupric oxide generated in the oxidation step by means of a cupric oxide cleaning solution; and reducing Cu deposition on a cathode-like copper wiring line of a Cu-dual damascene structure.
- [c10] 10.The process of claim 9 wherein the oxidation step is used to slightly oxidize a surface of a Cu wiring line in a dual damascene structure by utilizing a diluted H  $_2$  O  $_2$  solution.
- [c11] 11. The process of claim 9 wherein the cupric oxide cleaning solution comprises diluted HF, NH  $_4$  F, NH  $_2$  OH, or diluted HF/HCl.
- [c12] 12.The process of claim 9 wherein the oxide generated in the oxidation step comprises CuO  $_{\rm X}$  and Cu(OH)  $_{\rm 2}$  .
- [c13] 13. The process of claim 9 wherein the cathode-like copper wiring line is electrically connected with an N $^+$  diffusion region of a silicon substrate.
- [c14] 14.The process of claim 9 wherein the process of reducing Cu deposition on a cathode-like copper wiring line comprises purging an inert gas during the oxidation process.
- [c15] 15.The process of claim 9 wherein the process of reducing Cu deposition on a cathode-like copper wiring line comprises adding a Cu corrosion inhibitor to the diluted H  $_2$  O  $_2$  solution.



- [c17] 17.The process of claim 9 wherein the process of reducing Cu deposition on a cathode-like copper wiring line comprises reducing the H  $_2$  O  $_2$  concentration of the diluted H  $_2$  O  $_2$  solution to below 100:1 (v/v).
- [c18] 18.The process of claim 9 wherein the process of reducing Cu deposition on a cathode-like copper wiring line comprises lowering the temperature of the diluted H  $_2$  O  $_2$  solution during the oxidation step to below 15 ° C.
- [c19] 19.The process of claim 9 wherein the process of reducing Cu deposition on a cathode-like copper wiring line comprises increasing the pH of the cupric oxide cleaning solution to above 7.